COMMONWEALTH OF PENNSYLVANIA.

DEPARTMENT OF AGRICULTURE.

BULLETIN No. 48.

Common Cabbage Insects.

By H. T. FERNALD, Ph. D.,
State Zoologist.

PUBLISHED BY DIRECTION OF THE SECRETARY

WM. STANLEY RAY,
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DEPARTMENT OF AGRICULTURE,
DIVISION OF ZOOLOGY,
HARRISBURG, *May 12, 1899.*

HON. JOHN HAMILTON, *Secretary of Agriculture:*

SIR: I have the honor to offer for publication the following article on Cabbage Insects, as one of the Bulletins of the Department. The information contained therein has been prepared in response to inquiries received from a large number of growers of this important crop, and one of the insects treated of, though unknown to most of the cabbage growers of the State, has recently made its appearance in Pennsylvania and will before long be a serious pest, concerning which, information should be available for all who need it.

Respectfully submitted,

H. T. FERNALD,
Economic Zoologist.

CABBAGE INSECTS.

Cabbages form an important crop with most farmers, and this is particularly the case near cities. In such localities acres of this vegetable are grown and thousands of dollars are received from their sale each year.

While no reliable estimates of the size of the cabbage crop of Pennsylvania are obtainable, it is certain that it is worth several hundred thousand dollars each year to the growers and would be worth much more, were it not for the attacks of a number of kinds of insects which entirely destroy a portion of the crop and so injure much of the remainder as to greatly reduce its value.

Forty or more different insects feed on the cabbage, and nearly all of these are seriously destructive at times. Those most usual, however, are the cabbage worm, the Zebra caterpillar, the Cabbage maggot, and a new pest which has appeared in Pennsylvania within the last two or three years, known as the Harlequin cabbage bug. It is these four insects which are here treated.

THE IMPORTED CABBAGE WORM.

(*Pieris rapæ* Schr.)

The worm which causes most of the injuries to our cabbage is a European insect which first made its appearance in this county near Quebec about 1859. Until that time two closely related native species were the only ones causing loss, and they were seldom abundant enough to be of much importance. One of these inhabits the northern United States, and probably rarely occurs so far south as Pennsylvania. The other (Fig. 8, A), is common in this State, but is unimportant as compared with the imported species (Fig. 9, A male, B female).

From Quebec the imported cabbage worm spread rapidly until at the present time it is found nearly all over the United States and Canada.

Life History.

The insect passes the winter in quiet (pupa or chrysalis stage, Fig. 8, B), attached to a fence rail or other object. When spring comes the outer shell of the chrysalis bursts and the adult, winged butterfly appears, and as soon as the cabbages are set out these butterflies

proceed to lay their eggs on the leaves, one at a place. The eggs are rather smaller than the head of a pin and are pale yellowish at first, but later become more orange in color. They hatch in a few days and the young caterpillars feed on the leaves. If there are no cabbage or cauliflower plants available, when the butterflies are ready to lay their eggs, other (wild) plants of the same family (Cruciferæ) are selected instead, to lay the eggs upon, and the caterpillars feed on these. The caterpillars are velvety green in color and though at first very small, they grow rapidly until over an inch in length. They now leave the leaves and crawl away, either to the stalk of the plant or entirely away from it, till they find a protected place where they change their appearance greatly and become quiet, entering the

Fig. 8.—A, Southern Cabbage Worm Butterfly, natural size; B, Chrysalis of Imported Cabbage Worm on leaf, natural size.

chrysalis stage—the same in which their parents passed the winter. In a short time this stage ends and the second brood of butterflies appears, to repeat the life history as here outlined for the first brood. There may be several broods in a season.

Injuries.

The injuries caused by the cabbage worms are two-fold. They eat holes in the outside leaves of the cabbage and also bore into the head, and as their excrement is left wherever they go the injury they cause to any head they attack is often sufficient to prevent its being salable. As they feed on the cauliflower and turnip also, they cannot be regarded as of importance to the cabbage grower only, but to all who raise crops of this class.

Parasites and Treatment.

There are several parasites which feed upon this insect, and one or two insects which use it as an article of food. But in spite of this the cabbage worm is usually far too abundant, and treatment must be resorted to in order to protect the cabbages.

Many methods have been tried to destroy the worm. Saltpetre (one ounce to one gallon of water) has been highly recommended; alum, copperas, etc., but all have been tried and found wanting. If the application be made when the caterpillars are full grown, the chances are that on the next inspection few will be found. This does not indicate their destruction by the treatment, however, but only that having fed enough,the caterpillars have left the plant to

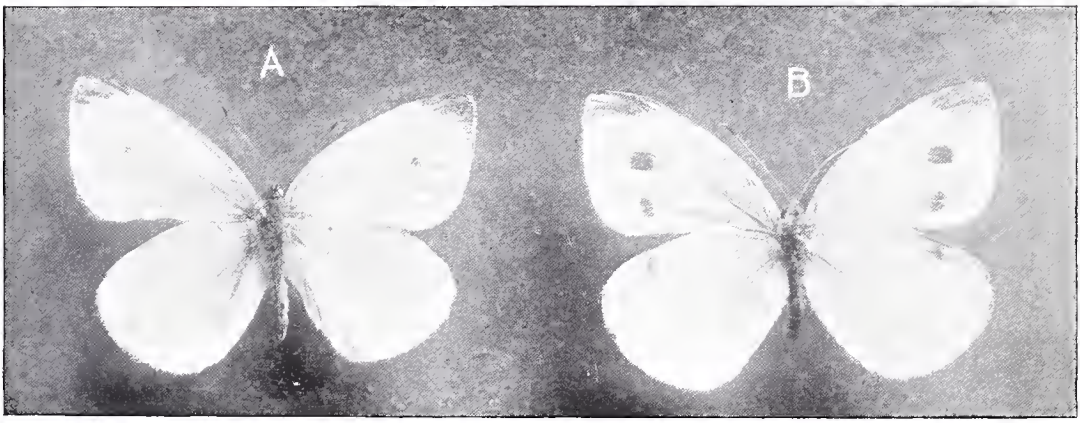

Fig. 9.—Imported Cabbage Worm Butterfly; A, male; B, female; both natural size.

find a satisfactory place in which to enter the chrysalis stage. Many "certain remedies" are found worthless in just this way, disappearance being supposed to mean destruction by those who watch the experiment.

Disregarding such so-called remedies therefore, we have left the following:

1. Hot Water. This is certain destruction to the cabbage worm if applied at about 130 degrees Fahrenheit. The water may be placed in the watering can when boiling hot, but will be about right by the time the cabbages are reached, and will seldom injure the plants. In any case a few trials will teach the experimenter about how hot the water should be to kill the worms without injuring the plants. The objection to this method is the time taken and the inconvenience of the treatment, which while it could easily be followed for a garden would be inadvisable in a field covering several acres.

2. Insect Powder. This treatment has been highly recommended. One hundred grains of the powder mixed with one gallon of water is sprinkled over the plants. This kills the caterpillars and is quite

effective. The difficulty, however, is to get good insect powder, most of it either being so adulterated as to be worthless or to have lost its strength in some way.

3. Kerosene Emulsion. This is certainly successful, in that it will in all probability kill every caterpillar with which it comes in contact. Moreover it is inexpensive, easily prepared and easily sprayed over the plants. The chief objections raised to it are that many of the worms being on the under sides of the leaves, do not come in contact with it and escape, and if the emulsion is used late in the season, some of the taste from the emulsion will be perceptible in the head. Whether these objections are legitimate or not is doubtful.

4. Paris green is now quite generally used by market gardeners as a remedy for the cabbage worm. Used early, it destroys the first broods of the insect and so reduces its numbers that the later broods have but few representatives. Danger of being poisoned by eating cabbages treated in this way is really exceedingly slight, as the head is not formed by outer leaves curling inward, but the reverse. Then too, the outermost leaves of the head should be (and generally are) removed in trimming the heads for market, and the last source of danger will in this way be removed.

5. Resin-lime Mixture. This mixture has recently been brought forward as better than the simple use of Paris green. It is reported on in the Bulletin of the New York Agricultural Experiment Station, No. 144, in which the following claims are made: First, that by it late cabbage and cauliflower can be protected from the attacks of the cabbage worm and cabbage-looper, by two sprayings. Second, that with cabbage the yield can be increased sixty per cent. to one hundred per cent. Third, that the cost per acre will depend on the number of acres sprayed, the cost of spraying ten acres twice being about $20. Fourth, that the mixture must not be applied to cabbage after the heads are two-thirds formed, nor to cauliflower after the "flower" is exposed. Fifth, that only skilled workmen should be trusted with the spraying of cauliflower.

The Resin-lime mixture is prepared as follows:

Stock solution:	Pulverized resin, ...	5 lbs.
	Concentrated lye, ...	1 lb.
	Fish oil or any cheap animal oil, except tallow, ...	1 pint.
	Water, ...	5 gals.

Place the oil, resin and one gallon of hot water in an iron kettle; heat till the resin is softened, then carefully add the solution of concentrated lye (prepared by the formula for making hard soap, always given on the can); stir the mixture and add the other four gallons of water, hot; now boil till the mixture will unite with cold water

and make a clear amber-colored liquid. Make up the whole to five gallons by adding water, when through boiling.

With this prepared, to make the solution used in spraying, take:

Resin mixture, as prepared above, ...	1 gal.
Water, ...	16 gals.
Milk of lime, ...	3 gals.
Paris green, ...	$\frac{1}{4}$ lb.

Bring these together in the order named, adding the Paris Green last, and spray the plants. Do not prepare this till it is to be used, as if it stands it will settle.

What the success of this method will be, can hardly be stated at the present time. Judging from the report made on it, it is worth trying by those who raise cabbages on a large scale, but has hardly sufficient advantages over other methods to pay, when used over less than two or three acres.

6. Fresh lime is often a very successful treatment for the cabbage worm. It is used by dusting the plants with it as often as any number of caterpillars make their appearance. It is necessary, however, that the lime should be fresh, and of course the smaller the caterpillars are at the time it is used the more quickly effective it will be. It should be applied in the morning while the plants are still covered with dew.

7. Where cabbage patches are small and no large areas are grown, it will pay to pick off and destroy the caterpillars and eggs; to look for the chrysalids (if boards are set in the ground on edge, here and there among the rows, many will be found on these), and to catch and kill the butterflies as they fly over the cabbages. Only the white ones need to be captured, the yellow ones of about the same size being clover feeders. For this work the active "small boy" is unexcelled, and his quick eyes will discern many eggs and caterpillars which older ones would overlook.

THE ZEBRA CATERPILLAR.

(*Mamestra picta* Harris.)

This insect is one of the most noticeable of our garden pests after it becomes half grown, the bright yellow, white and black stripes which run along its body, together with its pale red head making it a noticeable object as it feeds on the green leaves. It may be found in almost every garden, as it has quite a list of food plants, though it is not every year that it is abundant enough to be a serious pest.

Life History.

The Zebra caterpillar passes the winter in the ground, being at that time in the pupa stage. In the spring the moth escapes from the pupa, usually during May, and deposits its eggs. The caterpillars which hatch from these eggs feed through June and the early part of July, until full grown, then pass into the ground where they become pupæ and in this stage they remain for over a month, at the end of which time the moths from them appear. These lay eggs for the fall brood of caterpillars which feed through September and October, and at the end of the latter month, when full grown enter the ground to become pupæ and pass the winter.

From this life history it is evident that the feeding and injury to crops take place in June and early July, and again in September and October.

Injuries.

The Zebra caterpillar is quite a general feeder, not only attacking the cabbage, but also the turnip, beet, asparagus, pea, currant, spinach, strawberry, buckwheat and certain garden flowers as well. Hence it is well to watch all such plants for its presence.

Treatment.

The insect is not a difficult one to control, as the caterpillars have the habit of feeding in company while young. At such times the best treatment is simply to pick off the leaves they are on, and burn them. Later, after the caterpillars have separated, if hand picking will take too much time, the use of insect powder is advisable. To use this, take one part of the insect powder, and mix it with five parts of flour and sprinkle this over the infested plants.

As the caterpillar is a chewing insect, Paris Green can also be successfully used, where the plant on which it is feeding, is not soon to be used as food.

THE CABBAGE ROOT MAGGOT.

(*Phorbia brassicæ* Bouché.)

The Cabbage Maggot is present over the greater part of Europe and America and is often so abundant as to destroy entire crops. Besides the cabbage, it attacks the cauliflower, turnip, rutabaga and radish, and when present in abundance is a serious pest. It attacks the cabbages even before they are set in the field, and continues its injuries by its several broods until fall. It eats the rootlets of the young plants, injures the surfaces of the larger roots as the plants

grow larger, and even works into the inside of the roots and stalks. The result of this is not only to injure the power of the roots to do their work, but also to render them extremely liable to rot.

Life History.

The adult fly somewhat resembles a house fly in appearance. It appears in early spring and lays its eggs around the stems of the little plants at the level of the ground. The little whitish maggots which hatch from the eggs work downward to the roots where they feed, and sometimes cause these to swell up and resemble "club root." After two or three weeks the maggots are full grown, and become dark brown and quiet (pupa stage). After remaining in this condition for from fifteen to twenty days, the adult fly escapes from the brown pupa case and proceeds to lay its eggs for another brood.

Treatment.

A number of methods for the destruction of this insect have been tried with varying success. Of these, Carbon disulphide is probably as effective as any. To use this make a small hole in the ground near the main root of the plant to be treated, using a stick about the size of a cane. Into this hole pour about a half a teaspoonful of the Disulphide and at once fill up the hole with earth and press it down by the foot. This will destroy the maggots without injuring the plants, if the directions be carefully followed.

A method of prevention has also been tried with good success, as follows: Take tarred paper cut in circles or better in six sided pieces about three inches in diameter; cut a slit in to the center and from this point cut six short slits toward the six corners; place these pieces of paper around each plant as it is set out in the field, making certain that the stem of the plant which comes in the middle of the piece is closely fitted by the six short flaps, so that neither fly nor maggot can pass down through it to the roots beneath. Press the entire piece down till it rests closely against the surface of the ground.

This treatment prevents the insect from getting down to the roots of the young cabbage to feed, and is very successful. Whether it would pay for smaller growers is doubtful, as a regular cutter for these pieces is necessary, if the best results are desired.

When cabbages have been attacked by the cabbage-root maggot one year in a field, it is hardly advisable to attempt to raise cabbages there the following year, and some different crop should follow.

THE HARLEQUIN CABBAGE BUG.

(*Murgantia histrionica* Hahn.)

This insect, which is now becoming a serious pest in Pennsylvania, is a native of the South, inhabiting Central America. It was first noticed in Texas about 1866, since which time it has been slowly but surely spreading northward. As would naturally be supposed, this spread was most rapid in the lower and warmer districts, the result being that it proceeded north along the Atlantic coast, and up the Mississippi valley much faster than along the high mountainous regions between. It reached Missouri in 1870, Delaware in 1876, and since that time has appeared in injurious numbers in New Jersey and on Long Island, N. Y. West of the Allegheny mountains it has reached Ohio, Illinois, Colorado, Nevada and California, and is still spreading northward. As it has shown its ability to thrive and become destructive as far north as Denver, Col., it is probably safe to assume that it will extend as far north as Maine, Vermont, the southern portion of Quebec, and that no part of Pennsylvania will be too elevated—and consequently too cold—to permit of its ravages.

It made its appearance in Eastern Pennsylvania about three or four years ago; at first, few in numbers, but rapidly increasing in abundance and also in the amount of destruction it caused. In the western end of the State, however, its presence, though predicted, was not reported till the fall of 1898, when complaints from Fredericktown, Washington county, were received. As this place is on the Monongahela river it is evident that the insect has followed up the lower lands along the rivers, from the Mississippi, and up the Ohio, to its present location. For several years the central portion of the State will remain free from the insect, but spreading from both ends of the State, this region too, must ere long be invaded by it.

Life History.

The adult bug passes the winter in some protected place, such as under boards, leaves or rubbish, and appears in spring, seeking for plants on which to lay its eggs. This usually occurs early in May, the eggs being laid on mustard or early radishes, or if these are not available, on any plant, cultivated or wild, of this group, which may be found. The eggs hatch in a few days and the young larvæ thus produced, which somewhat resemble the adults, suck the juices of the plant till full grown. During this time they molt or "shed their skins" several times, growing larger and more like the adult each time, until as a result of this process they become adult. There is no quiet, resting "pupa" stage, such as has been described for the

cabbage worm and other insects, in this case. The adults thus produced, lay their eggs for a second brood, and these upon reaching maturity do the same, until the approach of winter. As the time required to develop a brood is short—only about two or three weeks—the number of broods in a season is considerable, and as each female

Fig. 10.—Harlequin Cabbage Bug. A, Adult Bug; B, half-grown bug; C, side view of mass of eggs; D, end view, showing the two rows. C and D much enlarged.

lays quite a number of eggs, the increase in numbers, as a result of this, together with the number of broods in a season, is a rapid one.

Injuries.

The amount of injury caused by this insect is very great; how great may be indicated by the following statements:

"I send for examination, by mail to-day, some specimens of a bug that for the last year has utterly destroyed the cabbage crop in this section, and this year, during the months of August and September, has blighted and ruined over a thousand heads of cabbage in my garden. After the cabbages were sucked dry, the bugs attacked my summer turnips and totally annihilated them. They then commenced to suck the bunches of late grapes and the shoots on some of my late corn, gathering in great numbers near the young silk."—Ivy Depot, Va. (Lintner).

Another cabbage raiser in Virginia writes that "last year it entirely destroyed the cabbage crop in his neighborhood, and that the present year, few cabbages have been set out; it has made sad havoc with his rutabagas, upon which they were still preying as late as the first of November." (Lintner.)

Though the insect has not been present in Pennsylvania long enough to have become as abundant as it will soon be, the following letter showing what it can do the very year it makes its first ap pearance, deserves to be quoted. "Last season I met with considerable loss by the appearance of a spotted bug (black with red or yellow spots) on the cabbage. They appeared in vast numbers in the latter part of the season and were very destructive."—W. C. O'Donnell, Fredericktown, Pa.

These extracts show for themselves how serious is this pest which

is now present in this State, and when we consider that it feeds on several plants besides the cabbage, its importance becomes still more evident.

Treatment.

The Harlequin cabbage bug is a difficult insect to control. Both the adult insect and the young, feed, and both are covered by a thick, hard shell or armor, which renders it difficult to kill them by contact poisons, such as kerosene emulsion, unless this be used so strong as also to kill the plant. As the mouth parts are not biting, but sucking, they receive their nourishment from the juices within the plant, and accordingly, arsenical poisons, such as Paris green, are useless.

With these facts in view, the following are the best methods of treatment now available:

1. Plant rows of mustard in among the cabbages, but before these are set out, thus giving the mustard a chance to start first. The bugs seem to prefer the mustard to the cabbages and gather on it, where they may be destroyed, either by spraying with pure kerosene, or by knocking the plants with a stick while holding a pan containing kerosene beneath.

2. If most of the first brood can be destroyed, there will be few left to produce the next, and later broods. For this reason it is advisable to search for the eggs in spring as soon as a few of the bugs, which had wintered over, appear on the plants to lay their eggs. These eggs are very small but quite noticeable. They are placed on the underside of the leaf, usually in two parallel rows, each row containing about half a dozen eggs. A row will be about half an inch long. The eggs themselves are at first green, but soon become white, with two black bands around and these bands, together with the form of the eggs makes them resemble white barrels with black hoops.

3. There are two parasites which prey upon this insect, and it is most desirable that they should be encouraged. One has been found in Maryland, but apparently not in great abundance. The other is found abundantly in Louisiana and it will undoubtedly pay to introduce this insect into Pennsylvania and set it at liberty in infested cabbage fields to attack and destroy the eggs of the bug there. The only question connected with this treatment is whether the parasite can, like the bug, survive the colder winters of this latitude, but even if it cannot, fresh importations every spring could undoubtedly be made to aid in holding this pest in check.

As this insect passes the winter protected by rubbish, clean cultivation, a thorough clearing out of fence corners, and the removal of all sticks, pieces of boards, etc., from the neighborhood of the cabbage fields is well worth the doing.